REMARKS/ARGUMENTS

Claims 1-10 were pending all of which stand rejected. Claims 1-10 have been amended. New Claims 11-17 have been added.

Drawing Objections

A set for formal drawings is submitted with this amendment. The formal drawings overcome the graphical problems identified in the Notice Of Draftsperson's Patent Drawing Review that was enclosed with the Office Action.

Claim Objections

Claims 7 and 10 were objected to as containing informalities. Claims 7 and 10 have been amended to correct the informalities.

Claim Rejections – 35 U.S.C. §102

Claim 1 was rejected under 35 U.S.C. §102(b) as being anticipated by Song et al. ("Song").

Song describes a process known in the industry as Lead On Chip (LOC), which is very different from the process claimed by the Applicants (col. 1, lines 9-10). In the LOC process of Song, an adhesive layer is applied to the "active surface" of the wafer, i.e., the surface on which the bonding pads are located (col. 2, lines 50-58). These bonding pads are located in a central region of the active surface of each die (col. 3, lines 61-64), The bonding pads must either remain exposed during the application of the adhesive or they must be opened following the application of the adhesive (col. 5, lines 4-38). The adhesive is deposited only on "lead attaching regions" of the die (col. 4, lines 25-27).

In contrast, in the process of this application the adhesive layer is applied to the surface of wafer opposite to the surface on which the bonding pads are located. This is evident from Fig. 3D, for example, where the bonding pads are located on the upper surface of die 300A and the epoxy layer 302 is attached to the lower surface of die 300A. In addition, the application makes it clear that, after the wafer has been sawed into dice, the adhesive layer covers the entire bottom surface of each die (see page 6, lines 23-25, and Fig. 3C).

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Claim 1 has been amended to recite these distinctions. For example, Claim 1 now recites "applying at least one nonconductive epoxy sublayer to said bottom surface of said semiconductor wafer using a screen printing process" and "said nonconductive epoxy layer completely covering a bottom surface of each of said semiconductor dice" (emphasis added).

The above-described amendments to Claim 1 are sufficient by themselves to distinguish over Song for the reasons stated above. Nonetheless, Claim 1 has also been amended to recite "applying a final nonconductive epoxy sublayer on top of said at least one epoxy sublayer" and "partially curing said final nonconductive epoxy sublayer such that said final epoxy sublayer is in a soft but solid form." The Examiner recited Song in view of Brouillette et al. ("Brouillette") as teaching "partially curing a final epoxy layer" (see page 5, line 1, of the Office Action). Brouillette was cited as showing that "it is a matter of design choice to form the film in either a single layer or multiple layers" (emphasis original)(see Office Action, page 4, lines 1-2).

The combination of Song and Brouillette is not sufficient to defeat the patentability of Claim 1 for at least the following reasons:

1. The combination of Song and Brouillette cannot be supported, because Song teaches away from Brouillette on the issue of the thickness of the epoxy layer. Song teaches that it is desirable "to reduce the size and thickness of the adhesive" (col. 2, lines 15-16, 36-37). Depositing the adhesive in multiple layers, as suggested by Brouillette, is contrary to reducing the thickness of the adhesive, as taught by Song. Thus, a person skilled in the art would not be motivated to combine the multiple layers of Brouillette with the partially cured layer of Song. Moreover, the desire of Song to reduce the thickness of the adhesive layer is directly contrary to the applicants' purpose of "providing a thick layer of nonconductive epoxy between the die and die pad to prevent a leakage current between the die and die pad" (emphasis added)(page 3, lines 3-5).

2. Brouillette merely comments in passing that the films "can be deposited in either a single or multiple layers." They do not teach the use of multiple layers as a means of increasing the thickness of the epoxy. This is a key element of the Applicants' invention. For example, the Applicants state that "the epoxy layer is normally applied in stages, as a number of sublayers. Each of the sublayers is cured, except for the final sublayer. . . .

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Applying the epoxy in the manner described to the surface of the wafer before dicing allows it to be made significantly thicker..." (emphasis added)(page 3, lines 11-21).

3. Brouillette describes a process that is very different from the process claimed by the Applicants. Brouillette describes a "method for direct chip attach of a semiconductor chip to a circuit board by solder bumps on the chip, conductive pads on the circuit board and a flux-containing under fill layer thereinbetween" (para. 0001). A key element of the process is the formation of solder bumps which are used to make the electrical connections between the chip and the circuit board. The polyimide layer is used as a "mask for the deposition of both the ball limiting metallurgy layer and the solder bump" (para. 0045). Applicants' epoxy layer is not used as a "mask layer." Applicants do not normally use solder bumps to make their electrical connections. Instead, the electrical connections in Applicants' process are typically made by wire-bonding.

For all these reasons, a person of skill in the art would not be motivated to combine the teachings of Song and Brouillette to realize the unique invention defined in Claim 1. Applicants do not argue that it is unknown to deposit an epoxy film in multiple layers or that it is unknown to partially cure an epoxy layer. They contend rather that it is not known or obvious to deposit multiple epoxy layers, leaving the top layer partially cured, in a process including the other limitations of Claim 1, to increase the thickness of an epoxy layer interposed between a semiconductor die and a die-attach pad.

Claim Rejections – 35 U.S.C. §103

Claims 2-4, 9 and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Song in view of Brouillette. The combination of Song and Brouillette is discussed above.

Claims 2-4 have been substantially amended. Each of these amended claims is clearly supported by the specification. Amended Claim 2 recites "wire-bonding said die-attach member to at least one of said bonding pads;" amended Claim 3 recites "said die-attach member comprises a pad;" amended Claim 4 recites "said die-attach member comprises a leadframe."

Each of Claims 2-4 depends from Claim 1 and is allowable for at least the reasons set forth above in connection with Claim 1.

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Claims 9 and 10 depend from Claim 1 and are also allowable for at least the reasons set for above in connection with Claim 1.

Claims 5-7 were rejected under 35 U.S.C. §103(a) as being unpatentable over Song in view of Brouillette and further in view of Babayan and Lin et al. ("Lin"). As regards Claims 5 and 6, Babayan and Lin were cited "to show the well-known process for forming/acquiring a B-stage adhesive." Further, the Examiner stated that "Babayan discloses (in Col. 5, lines 35-48) that a B-stage epoxy layer can be formed by heating in a range of about 90° C; and Lin discloses (in Col. 3, lines 43-58) that a B-stage adhesive is formed by heating in a range of 100° C for at least 60 seconds (i.e., for about one hour)."

Claims 5 and 6 depend from Claim 1. Applicants are unable to find any teachings in Babayan or Lin that overcome the deficiencies of Song and Brouillette insofar as the patentability of Claim 1 is concerned. For example, Lin fails to teach or suggest the deposition of multiple adhesive layers. Therefore, Claims 5 and 6 are allowable over the combination of Song, Brouillette, Babayan and Lin.

As regards Claim 7, Babayan and Lin were cited as disclosing "that a B-stage adhesive is conventionally cured at a temperature range of about 120 °C to 175 °C (note Babayan, Col. 5, lines 43-61; and Lin, Col. 4, lines 19-24 and lines 30-34)." Claim 7 has been amended to omit any references to temperature or time. These limitations have been inserted into Claim 8, which is allowable for the reasons stated below.

Claim 7, as amended, depends from Claim 1. Applicants are unable to find any teachings in Babayan or Lin that overcome the deficiencies of Song and Brouillette insofar as the patentability of Claim 1 is concerned. Therefore, Claim 7, as amended, is allowable over the combination of Song, Brouillette, Babayan and Lin.

Claim 8 was rejected under 35 U.S.C. §103(a) as being unpatentable over Song in view of Brouillette, Babayan and Lin and further in view of Cobbley et al. ("Cobbley"). Cobbley was cited as teaching "that commercially available die-attaching machines include means for applying a desired pressing force if necessary, e.g., a force in the range around 100 grams (note Col. 5, lines 14-33)."

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As noted above, Claim 8 has been amended to include some of the limitations that were previously in Claim 7. Claim 8, as amended, depends from Claim 1. Applicants are unable to find any teachings in Babayan, Lin or Cobbley that overcome the deficiencies of

Song and Brouillette insofar as the patentability of Claim 1 is concerned. Therefore, Claim 8, as amended, is allowable over the combination of Song, Brouillette, Babayan, Lin and Cobbley.

Claims 11-17 have been added. Claims 11-15 depend from Claim 1 and are allowable at least for the reasons set forth above.

Claim 11 recites that the die-attach pad "said die-attach pad comprises a plurality of contacts for a no-lead package." Claim 12 recites "wire-bonding at least one of said contacts for a no-lead package to at least one of said bonding pads." Claims 11 and 12 are supported by Figs. 10-12, for example. Claim 13 is supported by Figs. 14 and 15, for example.

Claim 14 recites "attaching a sawing tape to said epoxy layer before sawing said semiconductor wafer"; Claim 15 recites "sawing said semiconductor wafer from said top surface of said wafer, said sawing creating a cut that extends partially through said sawing tape." These limitations are supported at least in Figs. 5D and 5E and the accompanying text of the specification (page 6, lines 17-26).

Claim 16 is a new independent claim that contains some of the limitations found in Claims 1 and 3-10. Claim 17 depends from Claim 16. Applicants have reviewed the cited references and are unable to find that, taken individually or in any permissible combination, they teach or suggest the limitations of Claims 16 and 17.

For the above reasons, Applicants respectfully request allowance of Claims 1-17. Should the Examiner have any questions concerning this response, the Examiner is invited to call the undersigned at (408) 982-8201.

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